

MITES OF THE FAMILY CALIGONELLIDAE (ACARINA)¹**FRANCIS M. SUMMERS² and EVERT I. SCHLINGER³****INTRODUCTION**

POSSIBLY AS MANY AS 27 GENERA of closely related prostigmatic mites comprise a recently proposed superfamily, the Raphignathoidea Grandjean 1944. By and large the systematics of this group are poorly understood, and the component genera have had various assignments to family groupings. Older students classed these mites with the Trombidiidae or Tetranychidae. Most were later assigned to the Raphignathidae Kramer 1877. In 1931, Oudemans proposed the family Stigmaeidae for a dozen raphignathid genera having either independent or fused chelicerae and superficial tracheal trunks on the antero-lateral margins of the propodosoma. Oudemans restricted to the Raphignathidae the few genera having tetranychid-like peritremes. A third family, the Caligonellidae, was created by Grandjean (1944) for a monobasic genus, *Caligonella*, based upon *C. humilis* (Koch). This family was set apart on the basis of distinctive features of the respiratory apparatus associated with the mouthparts. More recently, Baker and Wharton (1952) placed the Stigmaeidae and Caligonellidae in synonymy under Raphignathidae on the grounds that in two recently discovered genera the characters of the three families are merged.

Much uncertainty still exists about raphignathoid taxonomy because the foundational genera, *Raphignathus* Dugès 1834, *Caligonus* Koch 1838, and *Stigmaeus* Koch 1838, are based upon little-known types. Since Koch's time these genera have become catchalls as well as sources of types for new genera.

The new genera and species herein described are assigned to the family Caligonellidae in the belief that these genera constitute a discrete family group. Since the diagnostic characters of this family and its type genus have been given only indirectly, by reference to the type species, *C. humilis*, a discussion of this matter may clarify the decisions involved in setting forth the diagnosis. It now appears that it may be possible to define three families of raphignathoid mites according to differences in the superficial parts of the respiratory apparatus associated with the mouthparts. However, there

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remains an element of uncertainty about the functions of the parts to be described—whether the peritremes and associated vessels are actually components of the respiratory system. Some of the vessels generally accepted to be parts of the respiratory apparatus possibly may be ducts of glands, as indicated for the Trombiculidae by Wharton and Fuller (1952).

In raphignathoid mites the principal internal tracheae of the idiosoma converge within the capitulum to form a sclerotized, Λ -shaped anastomosis. Connecting with the sidearms of the " Λ " are paired lateral ducts which lead upwards and outwards, around the external margins of the cheliceral bases and over the coxal areas of the capitulum. Each lateral duct passes from the gnathosoma to run superficially beneath the pleural integument of the propodosoma. It runs posteriorly to the vicinity of a peglike sensillum, or supracoxal spine, situated above the coxa of leg I. At this point the superficial duct curves to the interior of the body and divides into several small tubules resembling annulated tracheae of the orthodox type. The superficial ducts occur in all of the raphignathoid genera so far examined by the writers. They have been illustrated for *Caligonella humilis* (Grandjean, 1946), *Stigmaeus bdelloides* and *Zetzellia alni* (Oudemans, 1931). They have also been described in *Retetydeus viviparus* (Grandjean, 1938).

In raphignathoid mites having independent chelicerae—*Stigmaeus*, *Eustigmaeus*, *Mediolata*, *Ledermülleria*, and an assortment of unidentified but related genera—a definite anterior respiratory aperture (stigma) has not been found. Structures corresponding with the peritremes of Tetranychidae, Cheyletidae, Pterygosomidae, etc., appear to be undeveloped.

Other species of raphignathoids now assigned to *Raphignathus*—and possibly some of those in genera of uncertain validity, such as *Caligonus* and *Syncaligus*—possess attenuated peritremes. In these species, paired vessels originate from the anteriormost apex of the internal anastomosis and rise to the dorsal integument behind the fused chelicerae. The vertical vessels ascend in the basal notch of the stylophore and are confluent with paired "cervical peritremata." The latter diverge in the membrane joining the beak and body proper. Each peritreme terminates laterally in this membrane and is infolded when the stylophore is retracted. Cervical peritremes of this type have been illustrated for *Caligonus petrobis* (Berlese, 1886), *C. deserticola* (Trägårdh, 1904), *Raphignathus cardinalis* (Garman, 1948) and *Raphignathus* sp. (Baker and Wharton, 1952). It is probable that the species placed in *Syncaligus* by Berlese (1910) belong with this group.

Willman (1951) assigned to the Raphignathidae a new genus, *Acheleopsis*, based on *A. quadrioculata* Willm. His illustrations of the idiosoma and palpus indicate that this species is closely related to *Caligonella humilis* and therefore should be included in the family Caligonellidae. However, structural details of the complete gnathosoma are not described or illustrated, and since it has not been possible to obtain further information, the status of *Acheleopsis* in the Caligonellidae cannot be confirmed at present.

The species here designated as belonging in the Caligonellidae have the basal pieces of the chelicerae fused in the midline to form an integral stylophore. A pair of tubular vessels appears to originate from the apex of the underlying tracheal anastomosis and ascend to the dorsal surface of the

stylophore through its median septum. The vessels are continuous above with the paired "cheliceral peritremata," various patterns of which are to be described. The peritremes are deeply inscribed in the dorsal surface of the inflated portion of the stylophore, or they course laterally to end on lobular projections of its latero-basal walls. The peritremes are noticeably chambered or cross-braced. The cheliceral and peritremal arrangements suggest relationship with yet another group of mites—the Cheyletidae.

Caligonellidae Grandjean, 1944

Diagnosis: Relatively small, reddish-colored, free-living mites having inflated basal segments of stylete chelicerae fused with each other in midline to form a conical stylophore which bears on its dorsal surface a pair of sinuous peritremata; the latter confined to stylophore as alveolate channels ending blindly on inflated portion of stylophore or on paired earlike lobules appended to its lateral walls. Palpi 5-jointed, with single, well-defined claw on each tibia. Palptarsus at least as long as tibial claw, slender, cylindrical, arising on distal half of palptibia; equipped apically with stubby specialized setae, none of which are trifurcate or comblike. Integument of idiosoma finely striated, unarmored, or with dorsal plates. Eyes: 0 to 2 pairs. Coxae I–II and III–IV adjoining, the two groups of each side approximate but not contiguous. Pretarsi with two claws and falciform empodia from which arise two or more pairs of splayed capitate tenent hairs. Anal pore terminal or subdorsal.

KEY TO GENERA

Females

1. Idiosoma discoidal; legs stiltlike, slender, all much longer than idiosoma
Neophyllobius Berl.
- . Idiosoma elongate ellipsoidal to pyriform; legs not appreciably longer than idiosoma 2
2. Stylophore with lobular appendages arising on its latero-basal surfaces 3
- . Stylophore without marginal lobules 4
3. Stylophore short, thickset, basal half inflated; peritremes forming ornate loops on its dorsal surface *Coptocheles*
- . Stylophore elongate, conical, tapered to bifid point in front; peritremata not forming ornate loops on its dorsal surface *Stigmagnathus*
4. Peritremata arising on anterior tip of stylophore, in front of stylet bases
Caligonella Berl.
- . Peritremata arising dorsally on middle portion of stylophore, close behind stylet bases *Molothrognathus*

Caligonella Berlese

Diagnosis: Relatively small, soft-bodied mites having no obvious dorsal plates (smooth integument over eyes and tiny lenticular areas at bases of body setae not herein referred to as dorsal plates). Two pairs of eyes. Stylophore bullet-shaped; fixed digits (spinae) undeveloped, at least not present as slender, spinous processes; stylets short, articulating with extensive basal sclerites anchored within rounded anterior end of stylophore. Peritremata arise on anterior tip of stylophore, terminate on its dorsal surface. Palpus stubby, total length not exceeding that of femur I; claw small in relation to palptibia.

Type species: *Caligonella humilis* (Koch). By original designation (Berlese, 1910).

Oudemans (1903) proposed a monobasic genus *Acheles* for *A. mirabilis* Oudms. Later (1923 a, b) he decided that *A. mirabilis* was identical with *Stigmaeus humilis* Koch and transferred the species to *Raphignathus*. According to this opinion, *Acheles* and *Caligonella* should be synonyms of *Raphignathus* Dugès. However, Oudemans's brief description of *Acheles*

mirabilis as having five dorsal plates does not appear to describe *Stigmaeus humilis* Koch *sensu* Berlese.

Caligonella is retained for *Stigmaeus humilis*, as first re-described by Berlese (1886) and more recently by Grandjean (1946).

Caligonella humilis (Koch)

(Plate 1, figs. 1-4; plate 9, fig. 34)

Stigmaeus humilis Koch, 1838. Deutschl. Crust., Myr. u. Arach., Fasc. 17, fig. 3; Koch, 1842, Übers. d. Arachn., Heft 3, Abb. 3. p. 54.

Caligonus humilis Koch: Berlese, 1886, Ac., Myr. et Scorp. Ital., Fasc. XXII, no. 5, pl. 69; G. Canestrini, 1889, Atti Reale Ist. Ven. Let. Sci. Arti, Vol. VII (VI): 528-9, pl. VIII, fig. 11.

Caligonella humilis (Koch): Berlese, 1910, Redia, 6: 203; Grandjean, 1944, Arch. des Sci. phys. et nat., 5^{me} période, Vol. 26: 105; Ibid., 1946, Vol. 28: 82-7, fig. 5.

Female. GNATHOSOMA. Compact, over-all length to tip of tibial claw approximately equal to one-fourth length of idiosoma. Chelicerae with proximal components completely fused in midline, comprising a bullet-shaped stylophore; fixed digits not drawn out into spinous processes; movable digits (stylets) short, scarcely projecting beyond tip of stylophore when retracted. Peritremata conspicuous, confined to dorsal surface of stylophore, each appearing to communicate with tracheal system at anteriormost end of stylophore; thick-walled, with intricate pattern of polygonal septa or cross-braces; peritremes of greatest diameter near point of origin, tapered to smaller caliber at posterior, blind endings (fig. 1). Rostrum not longer than greatest width, stubby, emphatically truncate anteriorly. Palpus: over-all length approximately equal to that of femur I; femur and genu each with one long, simple dorsal seta; tibia with three simple setae and a small (6μ) curved claw; tarsus with eight heteromorphic setae: a minute, claviform sensillum (*solénidium*, Grandjean) projecting laterally near proximal end, three acicular setae, and a crown of four specialized setae (*eupathidies*) on apex. One simple seta on each coxal area of capitulum. IDIOSOMA.—Suboval, about one and one-half times as long as greatest width at anterior third, slightly tapered to broadly rounded caudal end. Integument with deeply etched striae; those of dorsum run lengthwise to a transitional area in posterior third, behind which their direction is essentially transverse. Longitudinal striae along middorsal line terminate abruptly in a transverse spindle-like pattern between 4th and 5th pairs of median setae; a looplike whorl occurs on each side of anal area. Eyes: apparently two on each side, anteriormost with a clearly discernible refractile body; adjacent posterior eye ill-defined. Eight very small, laterally placed "pores" occur in integument: one pair on propodosoma immediately behind eyes; three pairs on hysterosoma, one of which is on venter near genital pore. Dorsal setae: 11 pairs, subequal, placed as in illustration (fig. 3). Ventral setae: six pairs, anteriormost situated on flanges of coxae I and III (fig. 4). Anal covers with one pair setae. Legs with coxae of each side in two groups, interspace approximately equal to one-half greatest diameter of coxa II. Specialized sensilla of legs I and II include several of diagnostic value (fig. 34): genu I bears dorsally a minute spiniform sensillum (*épine*, Grandjean) near distal end; tibia I bears two small spiniform sensilla, both addorsal, opposite, arising from separate alveoli, outermost twice as long as inner companion and characteristically bent; tarsi I and II each with a single, relatively long claviform sensillum situated dorsally. Empodia blade-like with two pairs capitate tenent hairs not projecting beyond tips of claws (fig. 2). Measurements (single specimen): idiosoma, 0.31 mm long, 0.20 mm wide; leg I, 0.29 mm over all.

Male. Unknown.

Material. This description is based on a single specimen from Morongo Valley, San Bernardino County, California, March 19, 1952 (E. I. Schlinger), *ex* leaf mold of juniper. This is the first record of the species for the Western Hemisphere.

The above specimen was sent to Dr. Lombardini, Florence, Italy, for comparison with specimens in the Berlese collection. The writers are indebted to Dr. Lombardini for a

verdict that the specimen from California is identical with specimens of *Caligonella humilis* (K) identified by Berlese.

Grandjean (1946) thinks that complete fusion between the basal pieces of the chelicerae in this species has occluded primitive paired openings (stigmata) above and that an unpaired tube of *de novo* origin continues the respiratory passage further forward to a secondary *neostigma* on the anterior tip of the stylophore. According to this interpretation, the cheliceral peritremes of *Caligonella humilis* arise from the neostigma.

Molothrognathus, new genus

Diagnosis: Relatively small, soft-bodied mites having no obvious dorsal plates. Two pairs of eyes evident in mounted specimens. Stylophore conical, deeply cleft in front, with fixed digits projecting therefrom as conspicuous, fleshy, acuminate spines. Peritremata confined to stylophore, Ω -shaped, descending arms ending blindly on its latero-basal margins. Palpal genu with one pair acicular setae. Palptarsus a slender appendage not appreciably longer than tibial claw; equipped with one claviform sensillum on distal third, three acicular setae and a crown of four specialized setae on apex. One pair setae on venter of gnathosoma. Scapular setae may exceed all others in length.

Type species: *Molothrognathus leptostylus*.

Key to Species of *Molothrognathus*

1. Scapular setae much longer than other dorsal setae.....2
- Scapular setae not longer than other dorsal setae.....*M. leptostylus*
2. Idiosoma with 12 pairs dorsal setae.....*M. fulgidus*
- Idiosoma with 11 pairs dorsal setae.....*M. crucis*

Molothrognathus leptostylus, new species

(Plate 2, figs. 5–8; plate 9, fig. 3)

Female. GNATHOSOMA.—Slender, with short palpi, over-all length to tip of tibial claw equal to one-third length of idiosoma. Stylophore conical, deeply cleft anteriorly to form long acuminate fixed digits. Movable digits very slender, needle-like. Peritremata originate from vessels ascending between basal sclerites of movable digits; each peritreme passes posteriorly along margin of a middorsal trough or excavation, abruptly turns outward near membranous junction between idiosoma and stylophore to terminate on latero-basal margin of latter; polygonal pattern of cross-braces pronounced only in dorsal arms of peritremes; blind ends attenuate, thin-walled (fig. 6). Rostrum slender, elongate, tapered to blunt, notched tip; approximately as long as palps to base of claw; lateral margins incised at flexure in anterior third. Palpus slender, short; length to base of claw equal to that of trochanter and femur of leg I. Claw about two-thirds length of tibia. Tarsus barely overreaching tip of claw, equipped as follows: a tiny claviform sensillum on outer surface, subterminal; three acicular setae; a distal crown of four stubby, curved setae (*eupathidies*) having bluntly truncated tips (fig. 5). Coxal areas of capitulum with one pair long setae (37μ) below. IDIOSOMA.—Ovoid, widest in humeral region, approximately one and one-half times as long as greatest width. Integument striated, without identifiable dorsal plates; striae dual. Five pairs minute, integumental “pores” on idiosoma: one pair adjacent to posterior eyes; three pairs dorso-laterally on opisthosoma, middle pair between fifth and sixth dorso-medial setae; one pair posteriorly on venter. Dorsal setae: 11 pairs, all very short, subequal (fig. 7). Venter with seven pairs setae including those on sternal borders of coxae I and II (fig. 8). An additional pair on genital covers. Anal covers with two pairs setae. Legs slender, weakly developed in relation to body proportions; coxal groups separated by distance equal to that separating right and left coxae I. Specialized sensilla of leg I include: a small, spiniform sensillum above, near distal end of genu; two small sensilla addorsal, opposite, sharing a common alveolus on tibia—outermost spiniform about three times as long as inner claviform sensillum; one small claviform sensillum above on tarsus I (fig. 33). Tarsus II also provided with

one small claviform sensillum located dorsally near middle, noticeably smaller than that of tarsus I. Femur IV with only 1 seta. Empodia bladelike, bearing two pairs capitate tenent hairs. Measurements (10 ♀♀): idiosoma, 0.39 mm long, 0.25 mm wide; leg I, 0.25 mm over all.

Male. Smaller than female, resembling deutonymph of opposite sex. Chaetotaxy of idiosoma and appendages differs from adult female only in minor respects, as follows: genital area of venter bears only two pairs setae; uppermost pair of setae missing on anal covers. Shaft of intromittent organ straight, swordlike; wing-shaped supporting apodemes essentially V-shaped, convergent towards tip of retracted shaft. Measurements (2 ♂♂): idiosoma, 0.25 mm long, 0.16 mm wide; leg I, 0.20 mm over all.

Holotype. Female and three paratype females on one slide, Winters, California, April 8, 1952 (F. M. Summers), *ex* bark of almond trees. U. S. National Museum No. 2198.

Allotype. Male, Walker Pass, Kern County, California, March 30, 1952 (E. I. Schlinger), *ex* pine leaf mold.

Paratypes. Twenty-one females, one male, Winters, California, collection data as for holotype; one male, one female, collection data as for allotype.

Molothrognathus fulgidus, new species

(Plate 3, figs. 9–12)

Female. GNATHOSOMA.—Stylophore conical, sides evenly tapered, anteriorly cleft on midline to hindermost flexure of movable digits; fixed digit long, acuminate. Peritremata of uniform caliber, originating immediately behind basal sclerites of movable digits, diagonally cross-braced; descending arms run parallel some distance backwards, then diverge to end blindly on latero-basal margins of stylophore (fig. 9); a troughlike excavation between peritremes evident near emergence points of internal tracheae. Palpi (fig. 10) project beyond tip of rostrum by length of tibia and claw; total length, trochanter to tip of claw, equals combined lengths of genu and tibia I; tarsus proper not overreaching tip of claw, as long as greatest length of tibial segment. One pair long (35μ) ventral setae arising on rostrum near basal margins (fig. 10)—not on coxal areas of capitulum. IDIOSOMA.—Ovoid in outline, widest across scapular region, tapered towards oval end (in specimens not compressed). Integument finely striated; striae simple, closely set. Four pairs integumental “pores”: one pair adjacent to posterior eyes, two pairs dorsally, one pair ventrally on hysterosoma. Twelve pairs dorsal setae as follows: eight pairs relatively short; scapulars conspicuously long (67μ); adjacent dorso-laterals, par-anals, latero-terminals of intermediate length (fig. 11). Anus subdorsal, covers with two pairs very short setae. Venter with five pairs setae including a pair of median flanges of coxae I (fig. 12); those on sternal area more than twice as long as pair in front of genital pore. Genital covers with one pair setae. Legs slender, with coxal groups widely separated; legs I and II with specialized sensilla as described for *Molothrognathus leptostylus*; tibiae I to IV inclusive bear dorsally a conspicuously long, acicular seta. Femur IV with two setae. Measurements (10 ♀♀): idiosoma, 0.33 mm long, 0.18 mm wide; leg I, 0.24 mm over all.

Male. Not known.

Holotype. Female. Woodland, California, May 30, 1952 (F. M. Summers), *ex* bark of almond trees. Type slide with holotype, four paratype females, U. S. National Museum No. 2197.

Paratypes. Thirty females, data as for holotype; one female, Placerita Canyon, near Newhall, California, May 1, 1952 (S. F. Bailey), *ex* oak leaf mold; one female, Wheatland, California, May 20, 1952 (F. M. S.), *ex* almond bark; three females, Davis, California, July 30, 1952 (E. I. Schlinger), *ex* pansy foliage infested with *Tetranychus bimaculatus* Harvey; one female, Dairyville, California, May 22, 1952 (F. M. S. and E. I. S.), *ex* bark of prune trees; one female, Winters, California, April 8, 1952 (F. M. S.), *ex* almond bark.

A distinctive character of this species is the occurrence of 12 dorsal setae. Otherwise, a combination of characters is required to distinguish *Molothro-*

gnathus fulgidus from the two other species of the genus. Long scapular and caudal setae, and simple (not dual) striae readily distinguish *M. fulgidus* from *M. leptostylus*. On the other hand, the wide separation between coxal groups, and the shorter, slender legs differentiate the species from *M. crucis*.

Molothrognathus leptostylus and *M. fulgidus* have been taken in substantial numbers from the bark of almond trees infested with brown almond mite, *Bryobia praetiosa* K. Both of these caligonellids have been observed under natural conditions and are known to be slow-moving and secretive. Although they sometimes appear in exposed situations on twigs and foliage, they usually work in bark crevices or in crypts beneath masses of *Bryobia* eggs. Developmental stadia may be exposed when aggregates of *Bryobia* eggs and egg trash are pulled away from larger almond twigs.

There is evidence to indicate that these species feed on the eggs of the brown mite. Many individuals have been seen perched in feeding position on eggs of the host. Unfed individuals are dorso-ventrally flattened and reddish-amber in color. Plump individuals are cherry red, or approximately the color of *Bryobia* eggs. Samples of overwintered (post-diapause) *Bryobia* eggs removed from almond bark in late February show that about 30 per cent of these fail to hatch (Summers, 1951). Ingestion of egg substances by the suspected predators is difficult to detect, and there is no structural change in the appearance of the *Bryobia* eggs after the caligonellids move away. However, it is possible that a small amount of protoplasm is withdrawn through self-sealing punctures. Populations of *Bryobia* eggs include numbers of peculiar "empties"—intact shells having a faint reddish tinge and an equatorial band of darker red, dry matter. These eggs are possibly the victims of the predators.

Molothrognathus crucis, new species

(Plate 4, figs. 13–16)

Female. GNATHOSOMA. Stylophore conical, fleshy portion evenly tapered anteriorly to deeply notched tip beyond which project relatively stout, conspicuous, fixed digits. Basal sclerites of movable digits anchored far anteriorly in stylophore proper; stylets long, slender, tapered; in retracted position these project forward to tips of fixed digits. Peritremata arise dorsally on stylophore from paired vessels emerging within a median excavation immediately behind basal sclerites of movable digits; descending arms of large caliber, with frequent cross-braces; blind ends attenuate (fig. 14). Rostrum conical, one-third longer than greatest width at base, tip projecting slightly beyond distal end of palp femur. Palpus robust, over-all length to tip of claw about twice that of rostrum; claw stout, longer than tibial segment, extending forward to level of proximal seta on tibia I; tarsus as shown (fig. 13). One pair very long ventral setae arises on latero-basal margins of rostrum proper. IDIOSOMA.—Slender, fusiform, widest in region of scapular setae. Integument very minutely striated; striae simple, not discernible middorsally between four anterior pairs of dorso-median setae (fig. 15). Four pairs integumental "pores": one pair directly behind eyes, two pairs dorsally on opisthosoma, one pair ventrolaterally, close to genitalia. Eleven pairs dorsal setae of which three pairs are decidedly longer than others: scapulars longest (63μ), paranals and terminals about equal and of intermediate length (38μ). Venter with five pairs setae, including those on medial flanges of coxae I (fig. 16). Genital covers with one pair setae; anal covers with two pairs. Legs well developed, I and IV approximately as long as idiosoma; coxae in two groups, interval between II and III less than one-half diameter of coxa II. Inflexions of exoskeleton between contiguous coxae of each group form thickened apodemes, the medial

ends of which are emphatically reinforced; planes of apodemes between coxal I–II of one side and III–IV of opposite side nearly coincide—if planes of all intercoxal apodemes were projected to point of intersection on sternum, resultant figure would appear as a cross. Special sensilla of leg I include: a tiny claviform sensillum above on distal end of genu; two small, fusiform sensilla near distal extremity of tibia, these addorsal, opposite, sharing a common alveolus; a single, slender claviform sensillum on tarsus I, above on distal third. Tarsus II with a single claviform sensillum, this noticeably smaller than that of tarsus I. Tibiae I to IV inclusive bear dorsally a conspicuously long, acicular seta. Femur IV with 2 setae. Measurements (10 ♀♀): idiosoma, 0.34 mm long, 0.17 mm wide; leg I, 0.34 mm over all.

Male. Not known.

Holotype. Female, "The Gavilan," Riverside County, California, May 19, 1951 (E. I. Schlinger), *ex* oak mulch. Type slide with holotype, five paratype females, one deutonymph. U. S. National Museum No. 2199.

Paratypes. Five additional females, data as above; one female, Holbrook, Nevada, May 20, 1951 (E. I. S.), *ex* juniper duff; one female, Walker Pass, Kern County, California, March 30, 1952 (E. I. S.), *ex* bark trash, *Salix* sp.

A specimen from Tahoe Valley, El Dorado County, California, June 24, 1953, (E. I. S.), *ex* pine leaf mold, differs from type material in that five instead of three pairs of dorsal setae are appreciably longer than the others. One pair of dorso-laterals near the scapulars and the pair of dorso-medians next in front of the paranals nearly as long as the pair of terminals.

Molothrognathus fulgidus and *M. crucis* are closely allied species. The latter shows several distinctive features: 11 pair of dorsal setae (12 in *M. fulgidus*), peritremes of large caliber (cf. figs. 9 and 14), strongly reinforced intercoxal apodemes and extreme faintness or absence of middorsal striae.

Stigmagnathus, new genus

Diagnosis: Relatively small, soft-bodied mites having no obvious dorsal plates or eyes. Stylophore prominent, protruding, bifid at apex; fixed digits slender, hyaline, coextensive with retracted stylets. Peritremata confined to stylophore, W-shaped; outer (ascending) arms ending on small lobules projecting from sidewalls of inflated section of stylophore. Palpal genu with two pairs acicular setae. Palptarsus slender, elongate, projecting slightly beyond tibial claw; equipped with one claviform sensillum on proximal third, four acicular setae, and a crown of four spiniform setae at tip. Two pairs setae on venter of gnathosoma.

Type species: *Stigmagnathus spectabilis*.

Stigmagnathus spectabilis, new species

(Plate 5, figs. 17–20; plate 9, fig. 35)

Female. GNATHOSOMA.—Stylophore conical, twice as long as greatest width, sides slightly concave, bifid anteriorly with cleft extending backwards as a groove between anchor sclerites of movable digits. Fixed digits hyaline, bladelike processes with rounded tips. Retracted stylets coextensive with fixed digits, projecting beyond tip of rostrum. Paired lobules arise laterally on stylophore; these closely appressed to sidewalls of stylophore, aculeate, with points directed anteriorly (fig. 17). Peritremata approximately W-shaped arising on posterior fourth of stylophore; each loops around basal margin of stylophore and terminates forward on lateral lobule. Rostrum about as long as basal width between palptrochanters, over-all length approximately equal to length of palpfemur. Palpi stout, overreaching tip of rostrum by more than three distal joints; length of palpus to tip of claw equal to combined lengths of genu and tibia of leg I. Palptibia with two setae and stout claw. Palptarsus cylindrical, truncate at tip, slightly longer than claw; with nine setae, including subbasal, clavate sensillum. Two pairs long setae on venter of gnathosoma; anterior, shorter pair located on basal fourth of rostrum; posterior, longer pair directly behind, on coxal areas of capitulum (fig. 18). IDIOSOMA.—Oval in outline, nearly

twice as long as wide, gradually narrowing behind shoulders, round posteriorly. Integument covered with faint, closely set striae. Eyes not apparent in mounted specimens. Two pairs integumental "pores" dorso-laterally on hysterosoma, an additional pair on venter, opposite genitalia. Dorsal setae relatively short, unequal, 11 pairs including scapulars (fig. 19). Venter with nine pairs of setae, including two pairs on genital covers. Anus subdorsal, covers prominent, bearing three pairs setae. Legs with coxae in two groups. Gap between coxae II and III less than diameter of coxa II (fig. 20). Specialized sensilla of leg I include: one very small, spiniform sensillum on genu; one small, claviform sensillum on tibia; one larger claviform sensillum on tarsus, about three times as long as that on tibia (fig. 35). Leg II with corresponding sensillum on tarsus only. Tarsus IV with a small claviform sensillum resembling that of tibia I. Empodia blade-like, bearing three to four pairs capitate tenent hairs which project beyond tips of claws. Measurements (7 ♀♀): idiosoma, 0.34 mm long, 0.19 mm wide; leg I, 0.26 mm over all.

Male. Body smaller but with proportionately longer legs than female. Claviform sensillum of palptarsus well developed, about one-half as long as tarsal segment. Genu and tibia of leg I as described for opposite sex. A single, emphatically enlarged claviform sensillum on all tarsi of legs. Apodemata of internal genitalia complex in structure, with hyaline winglike expansions basally and tapered distally to a pair of bluntly barbed processes ensheathing tip of rodlike intromittent organ. Eleven pairs of dorsal setae, the last three pairs grouped around anal area; median pair noticeably short and spine-like. Five pairs ventral setae. Ano-genital covers with three pairs.

Holotype. Holotype female, three paratype females, and allotype male on one slide, Quincy, California, April 1, 1951 (F. M. Summers), *ex* manzanita leaf mold, U. S. National Museum No. 2193.

Paratypes. Five additional females, one male, with same collection data as for holotype.

Stigmagnathus terrestris, new species

(Plate 6, figs. 21-24)

Female. GNATHOSOMA.—General organization and proportions of parts closely resembling *Stigmagnathus spectabilis*. Stylophore bulged at sides to form a pair of small, rounded, lateral lobules. Peritremata W-shaped, arising on posterior third of stylophore. Inner, descending arms of peritremes run parallel to each other and close to middorsal line, then diverge posteriorly to loop around basal margins of stylophore. Outer, ascending arms terminate forward on lateral lobules (fig. 22). Rostrum one-third longer than basal width; length approximately equal to trochanter and femur of palpi. Palpi stout, overreaching tip of rostrum by three distal segments: genu, tibia, and tarsus; length to tip of claw equals combined lengths of genu and tibia I. Genu of palpus bears, distally, a minute thornlike dorsal apophysis. Tibial claw, palptarsus as illustrated (fig. 21). Two pairs of long setae on venter of gnathosoma; shorter, anterior pair on basal third of rostrum; longer, posterior pair on coxal areas of capitulum, setae of this pair twice as far apart as those of anterior pair. IDIOSOMA.—Elongate, twice as long as wide, margins nearly parallel on metapodosoma, gently narrowing on opisthosoma to round posterior. Integument covered with fine, closely set striae, the latter not perceptible on a pair of lateral areas over podosoma (fig. 23). No eyes apparent. Four pairs of integumental "pores" on hysterosoma: three pairs dorso-laterally, one pair ventro-laterally in genital area. Dorsal setae simple, 11 pairs, subequal. Anus terminal, two pairs setae on covers. Ventral setae: seven pairs plus two pairs on genital covers. Legs: coxae in two groups, separation between coxae II and III less than diameter of coxae III (fig. 24). Specialized sensilla of leg I include a very small spiniform sensillum on genu; an equally small claviform sensillum dorsally on tibia; a larger claviform sensillum on tarsus, this about twice the size of that on tibia. Leg II with corresponding sensilla on genu and tarsus but with claviform sensillum missing on tibia. Tarsus IV not provided with claviform sensillum dorsally as described for *S. spectabilis*. Measurements (10 ♀♀): idiosoma, 0.28 mm long, 0.17 mm wide; leg I, 0.25 mm over all.

Male. Not known.

Holotype. Holotype female, Glendale, California, Dec. 26, 1951 (E. I. Schlenger), *ex* leaf mold under *Cedrus deodora*. U. S. National Museum No. 2194.

Paratypes. Thirty-eight females, Holbrook, Nevada, May 25, 1952 (F. M. S. & E. I. S.), *ex* juniper leaf mold; 12 females, Alturas, California, Oct. 11, 1952 (E. I. S.), *ex* juniper leaf mold.

The anatomical characters which readily distinguish this species from *Stigmagnathus spectabilis* are as follows: peritremes with few nodes (3-4) or crosswalls; lateral lobules of stylophore present as rounded bloblike swellings which have no freely projecting processes; a minute spur or apophysis middorsally on genu of palp; no claviform sensillum on dorsal aspect of femur IV; three pairs of "pores" on the dorsal integument of hysterosoma; setae of the posterior pair on the venter of the gnathosoma about twice as far apart as the setae of the anterior pair.

Coptocheles, new genus

Diagnosis: Raphignathoid mites having sturdy, well-chitinized appendages and palpi armed with strong palpal claws. Stylophore fleshy, proximal half bulbous, equipped with paired lobules on outer, lateral surfaces; fixed digits represented by a pair of minute juxtaposed spurs; movable digits with short, blunt stylets. Peritremata arise dorsally, on mid-section of stylophore; these make sinuate patterns on its dorsal surface, then curve laterally to end on appended lobules. Dorsum of propodosoma provided with a pair of small ellipsoidal plates, one over each eye; an unpaired median plate occurs in only one of two species described.

Type species: *Coptocheles triscutatus*.

Coptocheles triscutatus, new species

(Plate 7, figs. 25, 27)

Female. GNATHOSOMA.—Stylophore well chitinized, pear-shaped, proximal half bulbous; anterior tip perceptibly bifid; fixed digits minute, spurlike; movable digits with stout basal sclerites and short, blunt stylets. Peritremata irregularly segmented or cross-braced, of uniform caliber, arising dorsally at center of stylophore; from point of origin each peritreme makes one hairpin loop to margin before approaching middorsal line where it abruptly turns posteriorly to run parallel with its mate; both peritremes curve outwardly near base of stylophore to end on earlike lobules appended to its lateral surfaces (fig. 27). Palpi robust, closely appressed to and accommodating cheliceral elements between their basal segments; diameters of free palpal segments as great as diameters of adjacent segments of first legs; each palp projecting four-fifths its length beyond rostrum, tip of claw reaches middle of genu I. Palptarsus cylindrical, not longer than claw; with one claviform sensillum dorso-laterally in middle, four acicular setae, and four specialized or spiniform setae (three terminal, one subterminal). Rostrum shortened, scarcely more than a conical process crowded between palp trochanters and proximal halves of femora. Two pairs setae in transverse row across basis capituli, behind base of rostrum. IDIOSOMA.—Ovoid in outline, propodosoma widest, opisthosoma slightly tapered to bluntly pointed posterior. Integument striated over most of body surface, dorsum of propodosoma bearing three chitinous plates as follows: one median pentagonal plate with apex lying between third pair of dorso-median setae; two small ellipsoidal plates, paired, overlying eyes. Exoskeleton of dorsal plates, mouthparts, legs, stippled with minute porosities. Eyes: possibly two pairs: one pair with definite refractile spheres; posterior pair—if present—very faintly discernible in mounted specimens. Four pairs dermal "pores" on body: one pair above, on propodosoma; two pairs dorsally, one ventrally on opisthosoma. Dorsal setae: 11 pairs, subequal, faintly pilose (fig. 25). Anus terminal, covers with three pairs setae, those resembling dorsal setae in size, pilosity. Venter with seven pairs setae: two pairs very long acicular bristles on sternal area, five pairs shorter setae on opisthosoma. Genital aperture situated well in front of anus, with two pairs setae (counted as ventrals) adjacent to genital covers. Legs with segments thickly sclerotized, I and IV approximately as long as idiosoma. Coxae of each side in two proximate but not contiguous groups. Genu, tibia, tarsus of leg I each bear dorsally a small claviform sensillum (fig.

32); only tarsus II similarly equipped. Pretarsi borne on moderately long pedicels. Empodia falciform, with four or more pairs short, capitate tenent hairs. Measurements (5 ♀♀): idiosoma 0.55 mm long, 0.33 mm wide; leg I, 0.52 mm over all.

Male. No appreciable differentiation between sexes; male closely resembles deutonymph of opposite sex. Aedeagus swordlike, consists of a slender, grooved shaft, expanded proximally, pointed distally; exserts through genito-anal atrium; without any visible complex of supporting sclerites internally. Claviform sensilla of leg segments as described for female, none of these hypertrophied. Dorsal pair of setae on anal covers reduced to very short spikelets.

Holotype. Female, Walker Pass, Kern County, California, May 30, 1952 (E. I. Schlinger), ex leaf mold of *Pinus montifolia*. U. S. National Museum No. 2195.

Allotype. Male, Alturas, California, Oct. 11, 1952 (E. I. S.), ex juniper duff.

Paratypes. One male, one female, same collection date as for holotype; three females, Walker Pass, California, March 30, 1952 (E. I. S.), ex leaf mold of *Salix*: one female, Johannesburg, California, April 19, 1949 (F. M. S. and S. F. Bailey), ex leaf mold of sage.

Coptocheles bobarti, new species

(Plate 7, figs. 26, 28)

Female. GNATHOSOMA.—Stylophore compact, as broad as long, basal two-thirds inflated, abruptly tapered in front to rounded, notched tip; a pair of cylindrical lobules arise on and are partly appressed to its latero-basal surfaces; these extend forward at an outward angle to terminate as finger-like projections near greatest width of stylophore. Fixed digits not evident from above. Movable digits with extensive basal sclerites; stylets short, not sharply pointed. Segmented peritremata emerge in middorsal line, close behind basal sclerites of movable digits, to make a series of loops on inflated part of stylophore; zigzag pattern consisting of three lateral hairpin loops followed by short descending arms which immediately curve laterally to end on marginal lobules (fig. 28). Rostrum and palpi essentially as in *Coptocheles triscutatus* (structure of palptarsus imperfectly known from type specimen). One pair ventral setae on basis capituli. IDIOSOMA.—Broadest in anterior fourth, gradually tapered to rounded posterior, a pair of deep marginal incisures near anal end. Integument covered with minutely tuberculated striae. Propodosoma bears dorsally one pair small, ellipsoidal plates, one over each eye; dorso-median plate absent. Eyes with refractile spheres; a second or posterior pair—if present—not discernible in cleared specimen. Integumental "pores" as described for genotype. Dorsal setae: 11 pairs, coarse, plumose; fifth and sixth dorso-medians shorter than others; those clustered on hinder part of opisthosoma stout, lanceolate (fig. 26). Anal covers with three pairs stout, lanceolate setae. Venter with seven pairs acicular setae as follows: two pairs on sternal area very long, three shorter pairs on opisthosoma, two pairs bordering (or on?) genital covers. Legs robust, coxae of each side in two proximate but not contiguous groups. Genu, tibia, tarsus of leg I and tarsus of leg II each with one small clavate sensillum situated dorsally; clavate sensillum of tibia I lies adjacent or shares its alveolus with a longer spiniform curved seta of a special type which appears on successive tibiae. Pretarsi on short pedicels. Empodia falciform, with a series of short, paired, capitate tenent hairs. Measurements: idiosoma, length 0.52 mm, width 0.31 mm; leg I, 0.53 mm over all.

Male. Not known.

Holotype. Female, Punta Rassa, Florida, Dec. 26, 1952 (R. M. Bohart), ex grass sweepings, U. S. National Museum No. 2196. A deutonymph obtained from same collection is not designated as type material.

The pattern of the peritremes, tuberculated striae, and the stout lanceolate setae on the anal end of the idiosoma are distinctive.

Neophyllobius Berlese

At the present time *Neophyllobius* comprises 16 species, the majority of which have been described from the United States by McGregor (1950). With the exception of *N. foroliviensis* Lombardini, 1943, these species con-

stitute a homogeneous taxonomic group. The phalangid-like appearance and ornate setae are distinctive, yet their affinities with other genera are not clear. In the past they have been classed with the red spider mites of the family Tetranychidae. McGregor (1950) acknowledged an opinion offered in correspondence by Dr. E. W. Baker, U. S. National Museum, and, accordingly, transferred *Neophyllobius* to the family Stigmaeidae *sensu lato*.

Neophyllobius is here referred to the family Caligonellidae in virtue of the anatomy of the mouthparts.

According to McGregor's description of the genus, the palpi are . . . "short, slender, 5-segmented, without the strong, talon-like claw on penultimate segment, but with two or more hairs, one of which may be blade-like." Alternately, on criteria of resemblance and point of origin on the palptibia, the "blade-like hair" also may be identified as a slender, slightly curved tibial claw. If the structure in question is indeed a true claw, then the relationship of *Neophyllobius* to other genera of the Caligonellidae is somewhat clearer. At best, however, it is an aberrant or atypical genus.

The gnathosoma of mounted specimens of this genus is usually difficult to examine because it does not exert far enough to become visible in its entirety. A recently collected series of specimens of *Neophyllobius lombardinii* has provided an especially favorable opportunity for examining the finer details of the mouthparts. The organization of the mouthparts as illustrated for *N. lombardinii* also applies in general to other species of the genus that have been examined, namely, *N. lamimani* McG., *N. burreli* McG., *N. summersi* McG., and *N. mexicanus* McG.

Neophyllobius lombardinii, new species

(Plate 8, figs. 29-31)

Female. GNATHOSOMA.—Stylophore truncate in front, without perceptible cleft or median septum; movable digits with short, pointed stylets, about three times as long as anchoring sclerites. Peritremata arise on dorsum of stylophore from paired vessels ascending between anchor sclerites of movable digits; each describes a simple arc to margin of stylophore before ending blindly near middorsal line; with three to five chambers or nodes (fig. 31). Palpi short, slender; femur with two obviously dentate setae; genu with one long, finely spinose seta; tibia with three acicular setae and a slender, slightly curved structure believed to be a claw (fig. 30); tarsus a slender, tapered, appendage bearing two acicular setae, one minute claviform sensillum, and one spiniform seta at apex; length of tarsus plus apical seta equal to tibial claw. One pair setae on venter of rostrum. IDIOSOMA.—Dorsal setae: 14 pairs, all coarsely dentate, arising on prominent tubercles; second, third, fourth pairs dorso-medians very conspicuously developed; third pair dorso-laterals located behind eyes shortest, while pair next behind are longest in marginal series. Variations in striae and texture of integument indicate presence of nine sclerotic areas or dorsal plates, as follows: one extensive unpaired plate covering most of propodosoma, four small unpaired median plates, two pairs lateral plates on margins of idiosoma. Anal pore in a ventral papilla, covers with three pairs very short setae. Genital covers with two pairs setae. Legs with setae arranged as shown (fig. 29). Special sensilla include: a minute spine on genua I and II, a spiniform sensillum on tibiae I to IV inclusive, a claviform sensillum proximally on tarsi I and II. Genua of legs all bearing a conspicuous seta longer than respective tibiae, lengths of genual setae increasing on successive legs according to ratio 1: 1.6: 2.1: 2.2. Measurements (10 ♀♀): idiosoma, 0.30 mm long, 0.23 mm wide; leg I, 0.59 mm over all; genual setae, I—0.066 mm, II—0.108 mm, III—0.136 mm, IV—0.147 mm.

Male. Not known.

Holotype. Female, Glendale, California, Jan. 1, 1951 (E. I. Schlinger), *ex* oak leaf mold, U. S. National Museum No. 2200.

Paratypes. Three females, same collection data as for holotype; 12 females, "The Gavilan," Riverside County, California, May 17, 1951 (E. I. S.), oak leaf mold.

Neophyllobius lombardini is an unusually striking species which closely resembles only *N. superbus* G. Canestrini 1889. In fact, the new species was tentatively identified by the writers as *N. superbus* on the basis of Canestrini's illustration of the female (Tav. XI, fig. 44). Dr. Lombardini was kind enough to compare a specimen of the species named in his honor with those of *N. superbus* in the Berlese collection. According to his opinion the American form is not conspecific with *N. superbus*.

All of the dorsal setae of *Neophyllobius lombardini* are beset with coarse, diverging spikelets, the length of the spikelets usually exceeding the diameter of the setae. The three pairs of long dorso-median setae are not tapered to points, and the basal tubercles of each pair are situated side by side, almost confluent on their median surfaces. Femur I bears four setae, about equidistant one from the other; femur IV with two setae of equal lengths. The dorsal setae of *N. superbus* are more finely dentate, and the denticles are closely appressed to the setal axes. The three pairs of long dorso-median setae taper from base to tip; the first two pairs with tubercles close together whereas tubercles of the third pair are set noticeably farther apart than those of the first two pairs of the long setae. In Canestrini's figure, femur I of *N. superbus* is shown with only three setae, two of these arising close together on the distal third of the segment; femur IV with two setae, the proximal one much shorter than the other.

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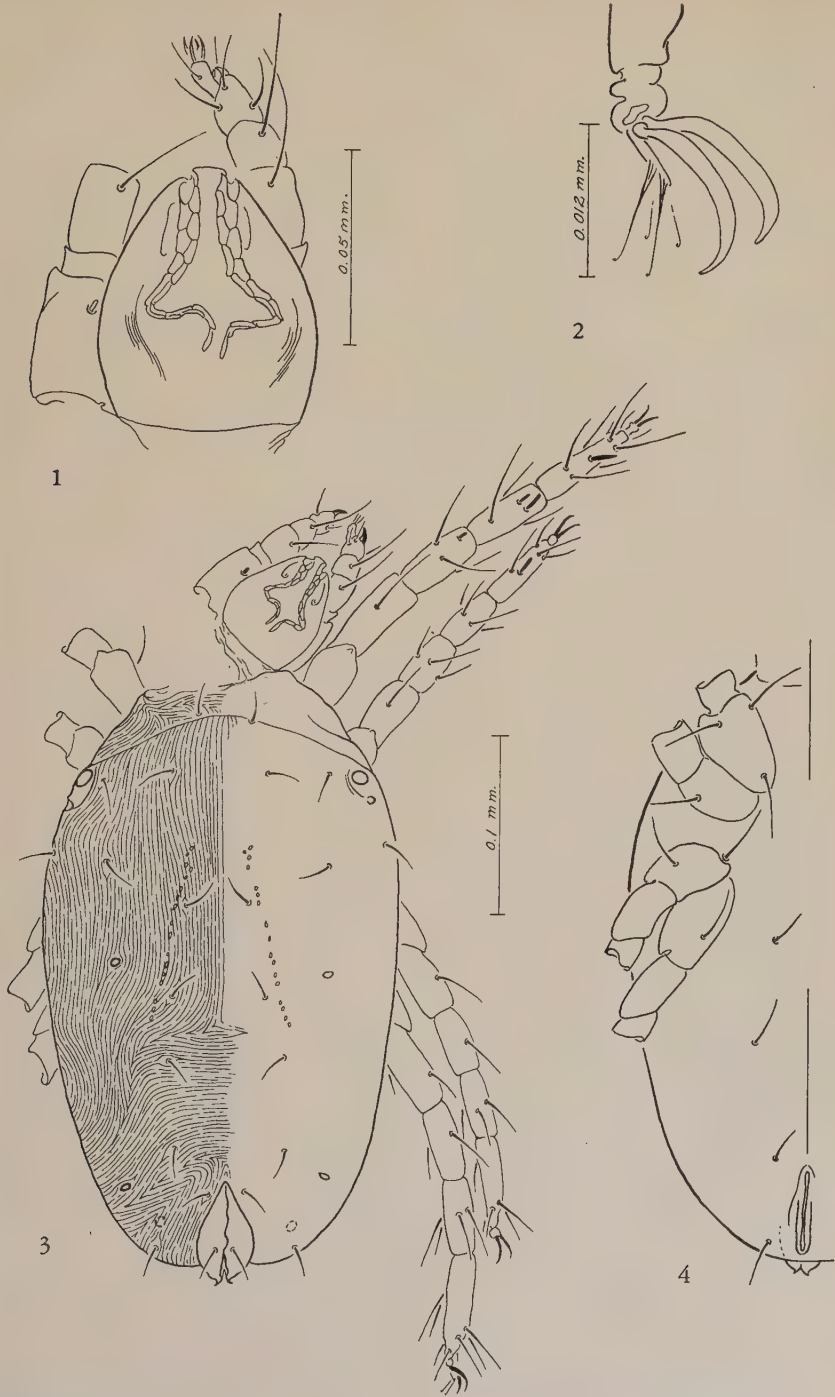
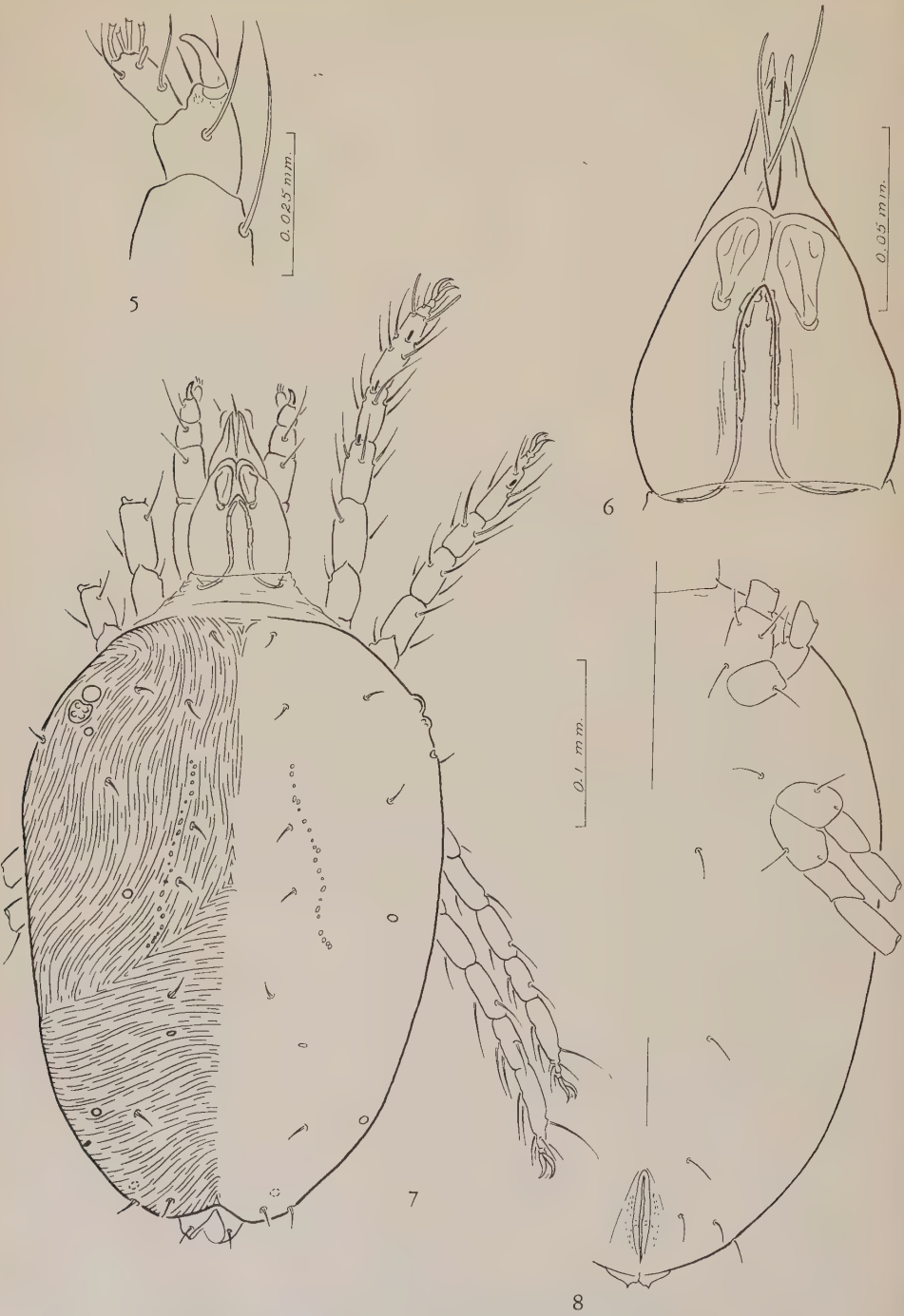


Plate 1. *Caligonella humilis*: 1, dorsal aspect of gnathosoma; 2, pretarsus of leg 1; 3, dorsal view of female; 4, venter of idiosoma.



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Plate 2. *Molothrognathus leptostylus*: 5, tip of right palpus; 6, dorsal view of stylophore; 7, dorsal aspect of female; 8, venter of idiosoma.

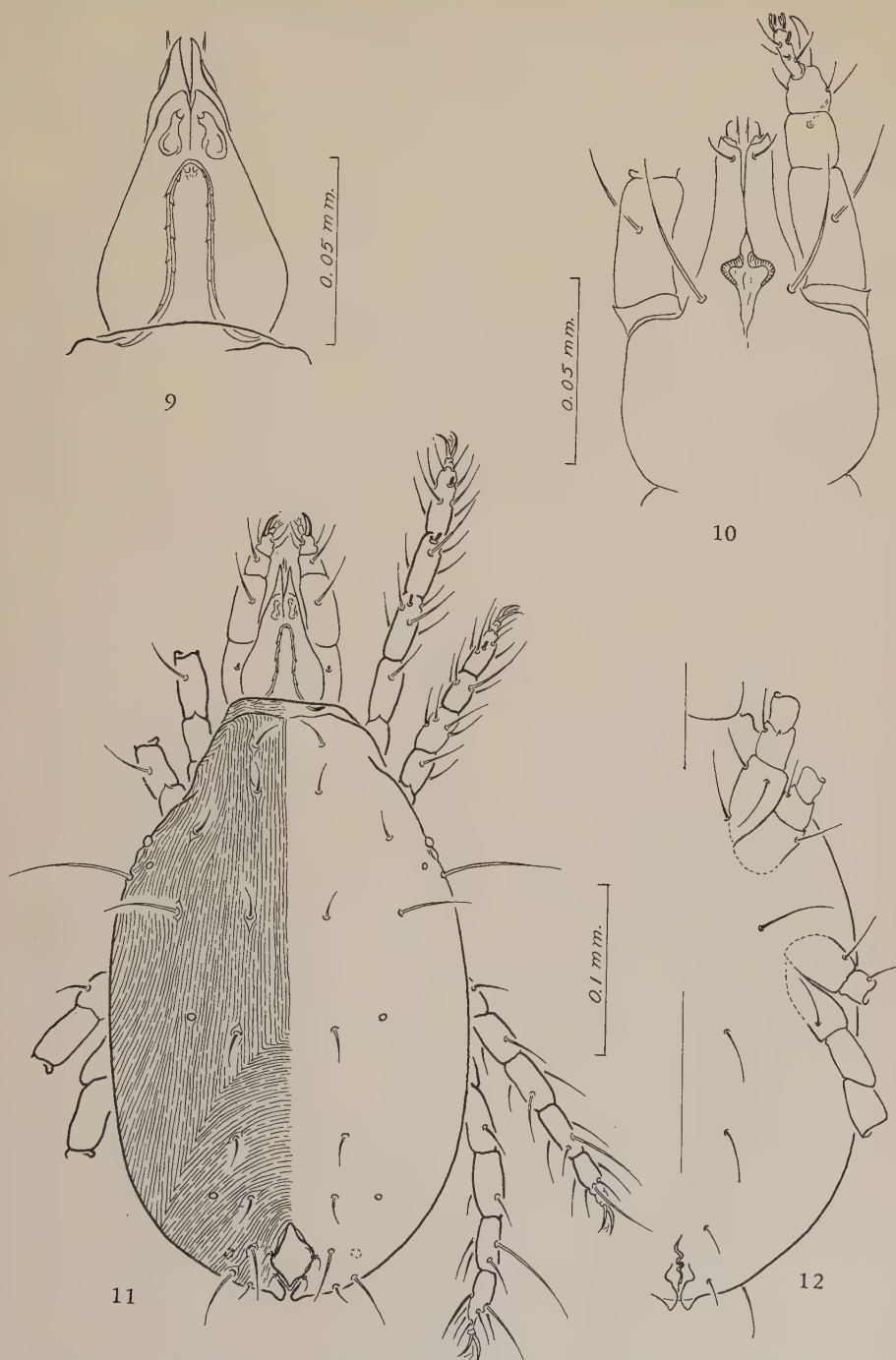


Plate 3. *Molothrognathus fulgidus*: 9, stylophore from above; 10, ventral view of gnathosoma; 11, dorsal view of female; 12, venter of idiosoma.

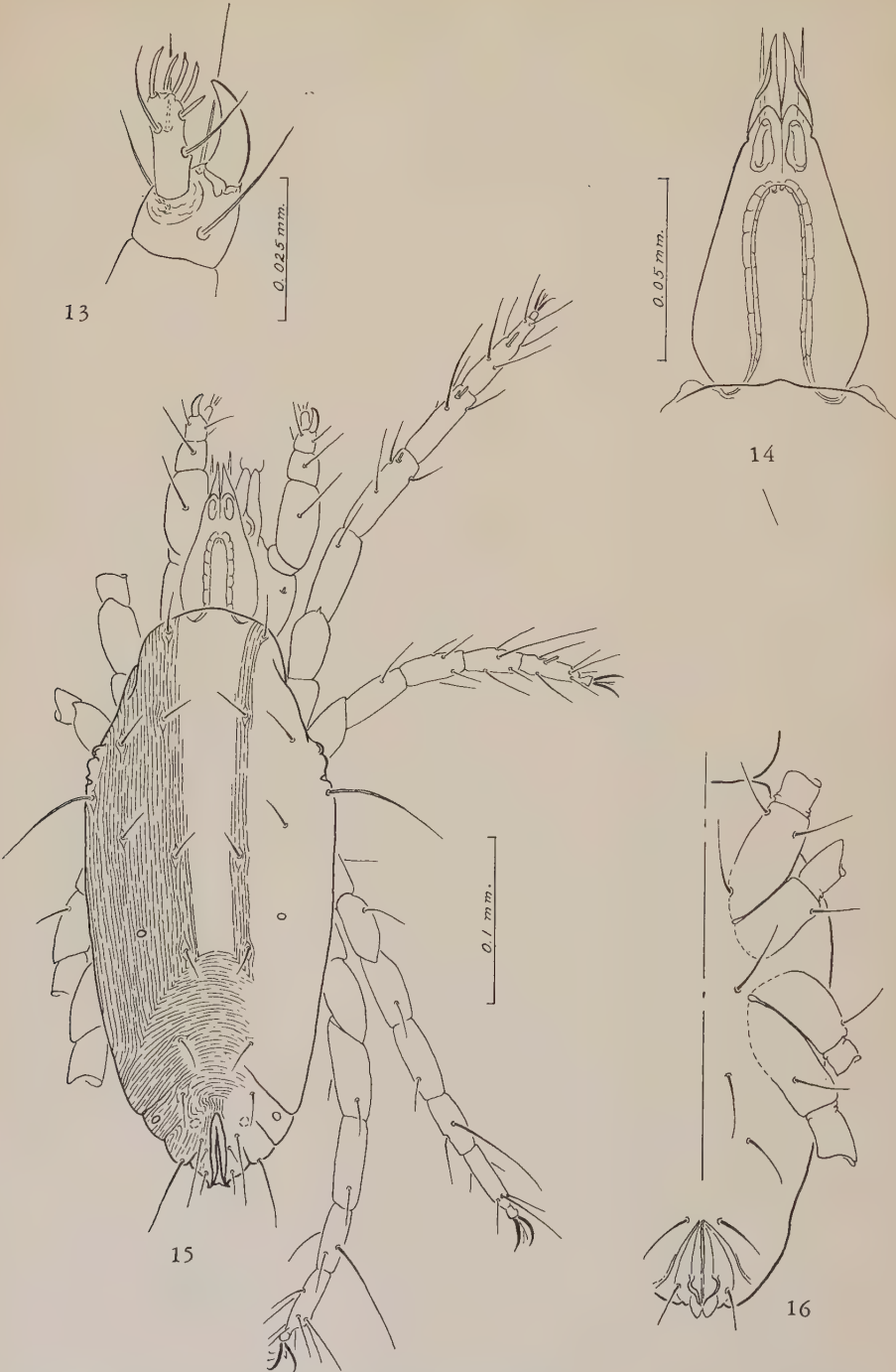


Plate 4. *Molothrognathus crucis*: 13, tip of right palpus; 14, dorsal view of stylophore; 15, dorsal view of female; 20, venter of idiosoma.

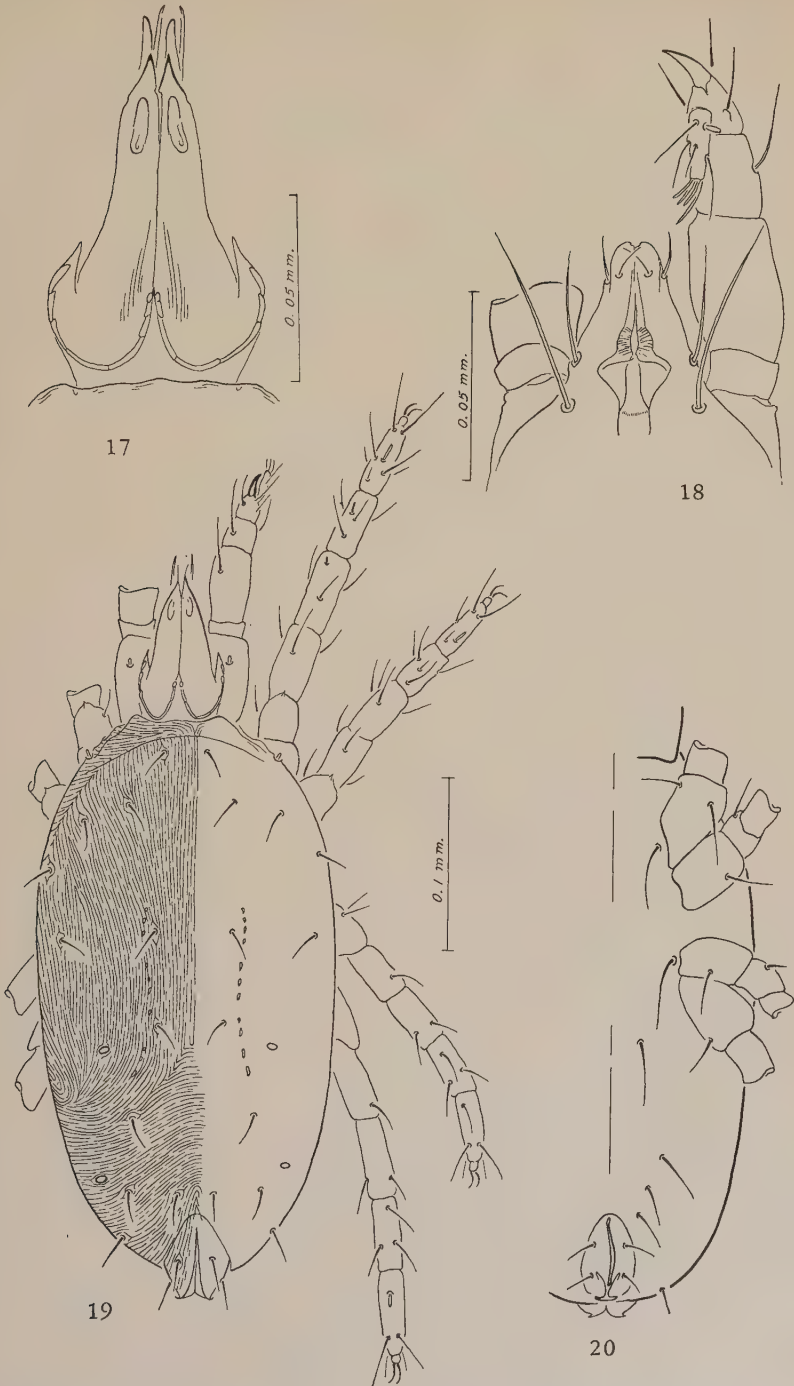


Plate 5. *Stigmagnathus spectabilis*: 17, stylophore from above; 18, ventral aspect of gnathosoma; 19, dorsal view of female; 20, venter of idiosoma.

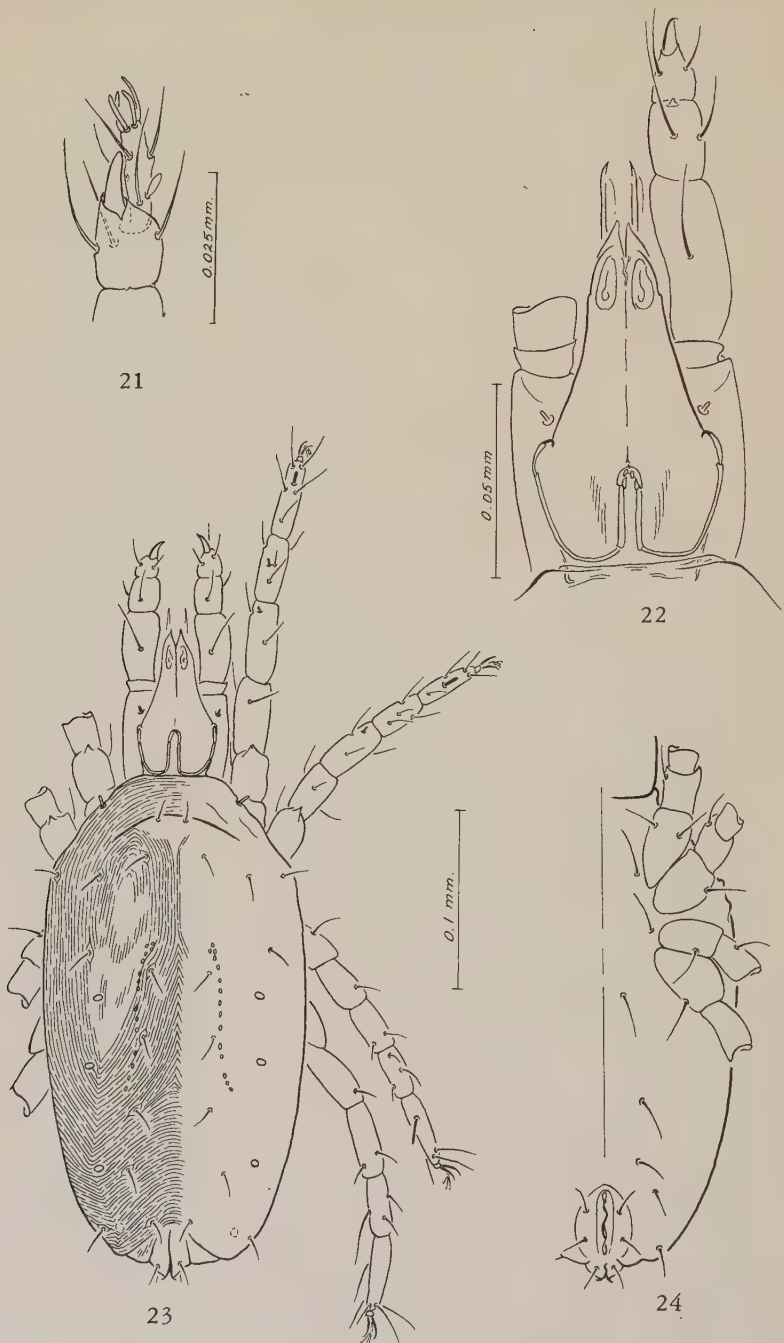


Plate 6. *Stigmagnathus terrestris*: 21, tip of right palpus from above; 22, dorsal view of gnathosoma; 23, dorsal view of female; 24, venter of idiosoma.

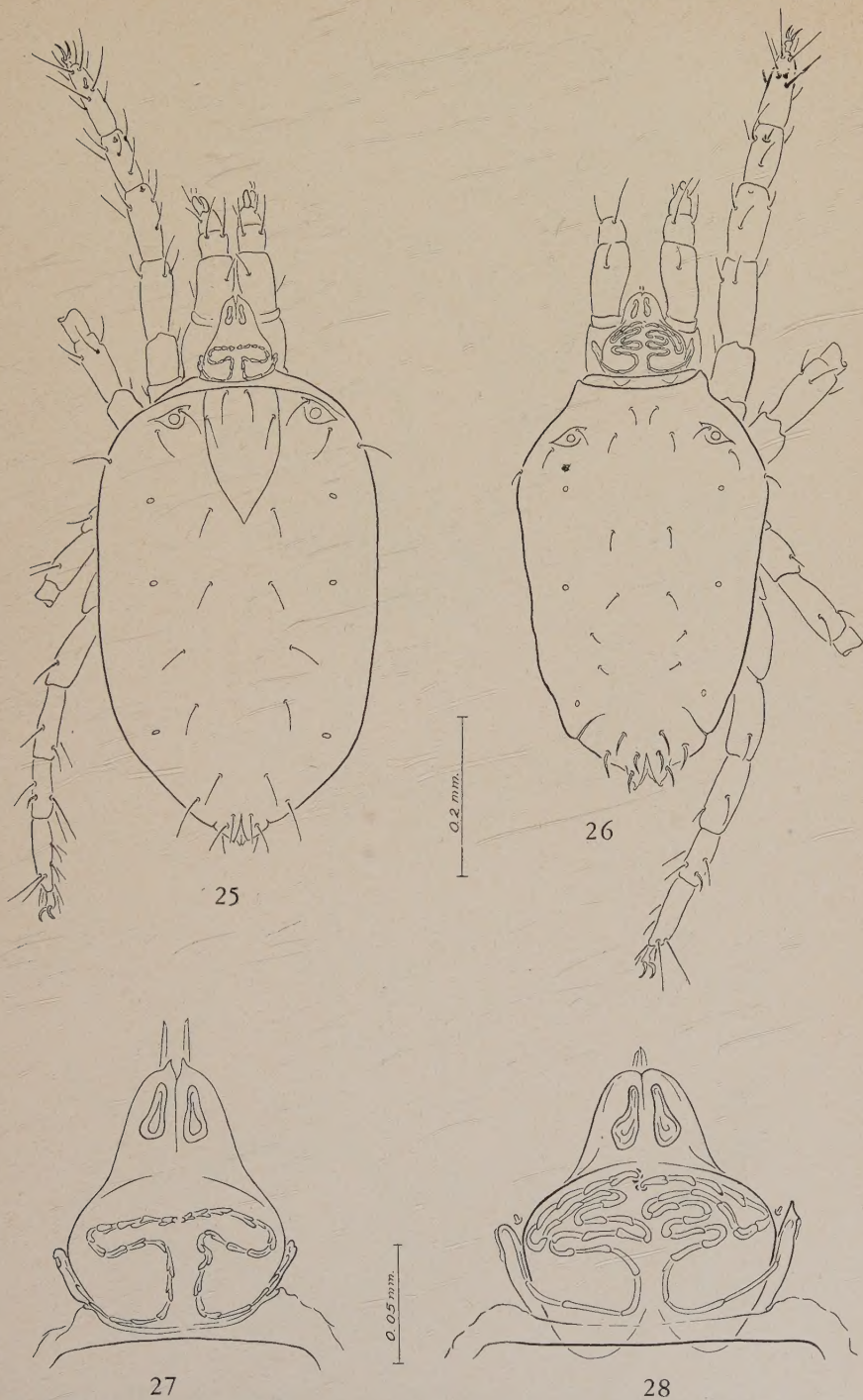
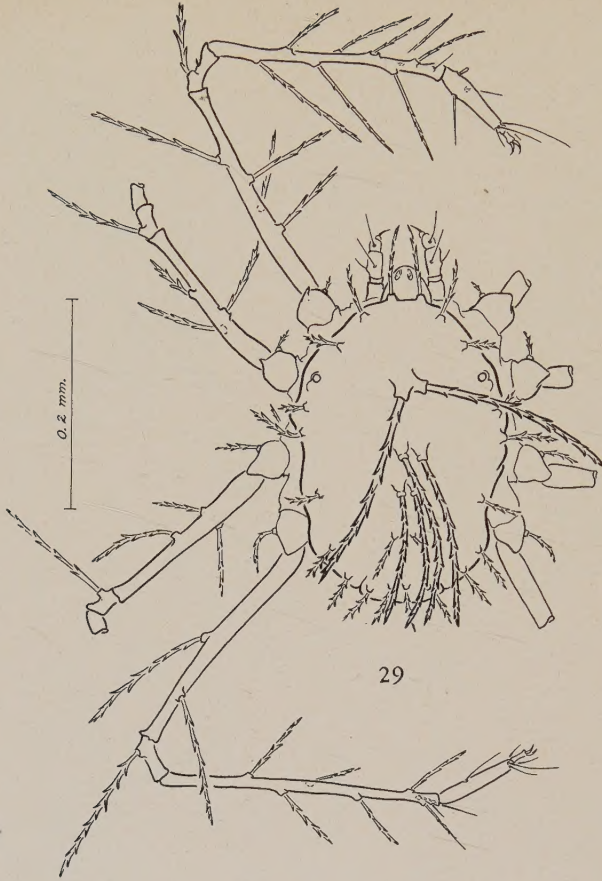


Plate 7. 25, Dorsal aspect of *Coptocheles triscutatus*; 26, dorsal aspect of *C. boharti*; 27, stylophore of *C. triscutatus*, dorsal view; 28, stylophore of *C. boharti*, dorsal view.



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Plate 8. *Neophyllobius lombardinii*: 29, dorsal view of female; 30, ventral aspect of left palpus; 31, gnathosoma from above.

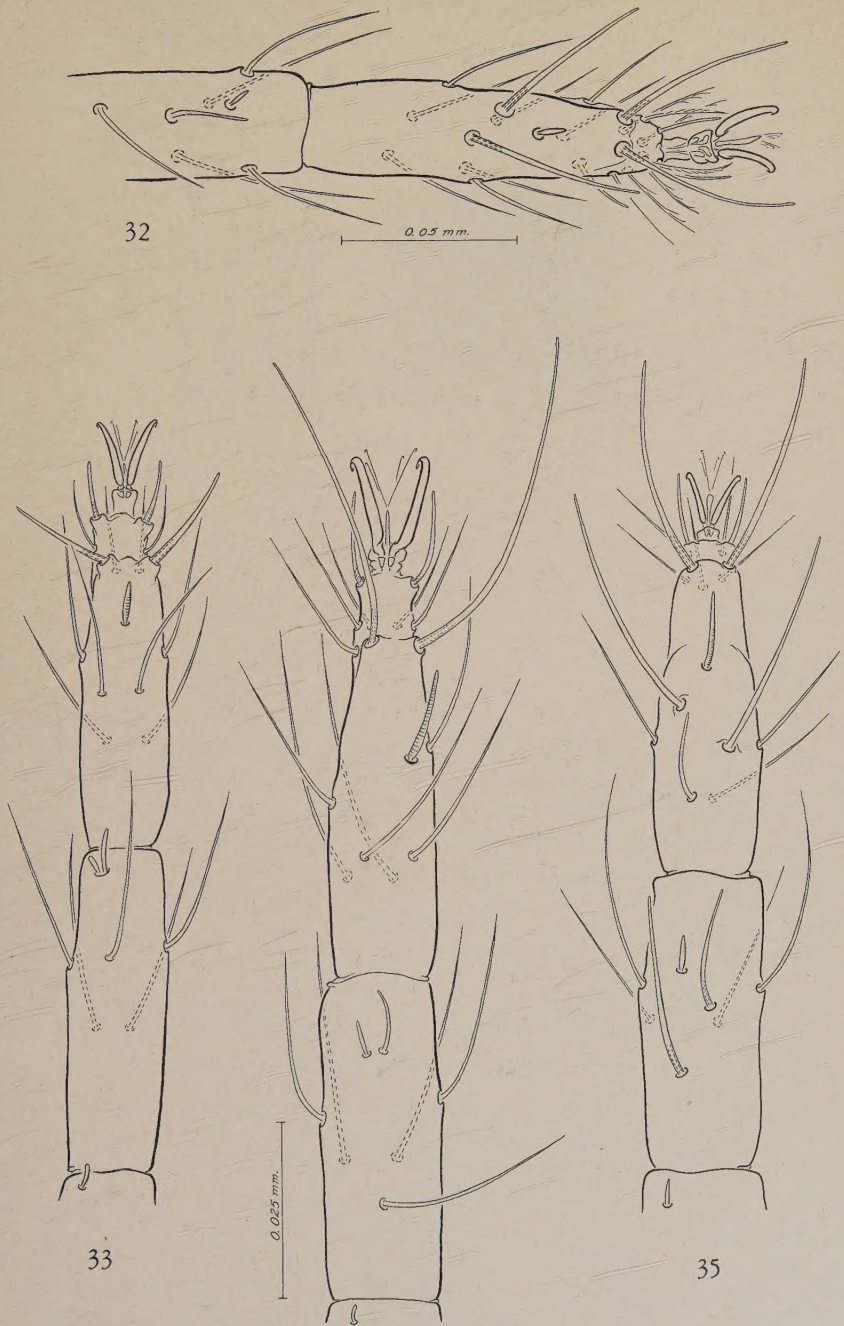


Plate 9. Distal segments of right forelegs of type species: 32, *Coptocheles triscutatus*; 33, *Molothrognathus leptostylus*; 34, *Caligonella humilis*; 35, *Stigmagnathus spectabilis*.

